REMARKS

In section 2 of the Office Action, the Examiner rejected claims 3-6 and 37 under 35 U.S.C §102(e) as being anticipated by the Bohlinger patent.

The Bohlinger patent discloses a magnetic field sensor 10 in the form of an integrated circuit. An integrated circuit die 12 has formed thereon a coil 14 that extends from a set or set reset pad 16 in a clockwise spiral and terminates at a pad 18. Magnetoresistive elements 20-28 and 30-32 are connected in a first Wheatstone bridge arrangement with power supply connections at Vcc1(X) and Vcc2(X) and output voltage connections Vout+(X) and Vout-(X). The direction of sensitivity of the first Wheatstone bridge is shown by arrow 33 and this bridge acts as the x-axis sensor.

Magnetoresistive elements 34-36 and 38-40 are shown connected as a second Wheatstone Bridge arrangement with power supply connections at Vcc1(Y) and Vcc2(Y) and output voltage connections Vout+(Y) and Vout-(Y). The direction of sensitivity of the second Wheatstone bridge is shown by arrow 41 and this bridge acts as the Y axis sensor.

The current through the coil 14 may be used to simply set the magnetization of the magnetoresistive

elements prior to a reading. The current may also be applied in one direction prior to taking a first reading and in the opposite direction before taking a second reading in a set/reset application. A current passing through the coil 14 generates a magnetic field that is perpendicular to the coil 14.

Independent claim 37 is directed to an integrated signal isolator in which a first portion of an input strap is disposed in closer proximity to a first magnetoresistor than to second, third, and fourth magnetoresistors, and in which a current through the first portion of the input strap flows in a direction that is parallel to the direction of current flow through the first magnetoresistor. Second, third, and fourth portions of the input strap are similarly disposed with respect to corresponding second, third, and fourth magnetoresistors. Also, a magnetic field is generated over the first and second magnetoresistors in one direction, and a magnetic field is generated over the third and fourth magnetoresistors in an opposite direction.

As can be seen from Figure 1 of the Bohlinger patent, the currents through the portions of the coil 14 closest to their corresponding magnetoresistors flow in a

direction that is perpendicular, not parallel, to the direction of current flow through their corresponding magnetoresistors.

Thus, independent claim 37 is not anticipated by the Bohlinger patent.

Because independent claim 37 is not anticipated by the Bohlinger patent, dependent claims 3-6 are likewise not anticipated by the Bohlinger patent.

In addition, dependent claims 4 and 5 recite that each of the first, second, third, and fourth magnetoresistors comprises a serpentine structure having a plurality of elongated magnetoresistive portions coupled end-to-end, that the elongated portions of the first and second magnetoresistors are in parallel to the first and second portions of the input strap, respectively, that the elongated portions of the third and fourth magnetoresistors are in parallel to the third and fourth portions of the input strap, respectively, that the first and second portions of the input strap carry current in a direction that is opposite to current carried by the third and fourth portions of the input strap, and that the first and second portions of the input strap are parallel to the third and fourth portions of the input strap.

As shown in Figure 1 of the Bohlinger patent, the elongated portions of the magnetoresistors are perpendicular, not parallel, to their corresponding portions of the coil 14.

For this additional reason, dependent claims 4 and 5 are not anticipated by the Bohlinger patent.

In section 3 of the Office Action, the Examiner rejected independent claim 11 under 35 U.S.C §102(b) as being anticipated by the Dettmann patent.

The Dettmann patent discloses a sensor chip 5 that has two areas I and II that are equally spaced from a center axis 15. The area I includes magnetoresistors 1 and 2, and the area II includes magnetoresistors 3 and 4.

The magnetoresistors 1, 2, 3, 4 each consist of three laminated interleaving magnetoresistive strips 1', 2', 3', 4', respectively, which are parallel to one another and which have barberpole structures 10. The magnetoresistor pairs 1/2 and 3/4 respectively form branches A and B of a Wheatstone bridge. The magnetoresistors 1 and 2, when exposed to opposed magnetic fields through the application of a current I_0, undergo opposite changes in resistivity. Similarly, the magnetoresistors 3 and 4 also undergo opposite changes in resistivity. Furthermore, the magnetoresistors 1 and 3

undergo opposite changes in resistivity, and the magnetoresistors 2 and 4 undergo opposite changes in resistivity.

The output of the Wheatstone bridge is fed to an amplifier whose output is the current I_{st} and forms the output signal of the arrangement. The output current I_{st} is a measure of the current I_0.

The current I_0 is supplied through lines 14, and an insulating layer 13 is formed between the sensor chip 5 and the lines 14. The current I_0 flows in one direction relative to one bridge branch A and in the opposite direction through the other bridge branch B.

Independent claim 11 requires the first and second magnetoresistors to be longitudinally displaced from one another and the third and fourth magnetoresistors to be longitudinally displaced from one another. The Dettmann patent discloses laminated magnetoresistors so that no magnetoresistor is longitudinally displaced from any other magnetoresistor.

For this reason, independent claim 11 is not anticipated by the Dettmann patent.

In section 4 of the Office Action, the Examiner rejected claims 3-17 and 31-37 under 35 U.S.C. §102(b) as being anticipated by the Wan patent.

The Wan patent discloses a first magnetoresistor 24, a second magnetoresistor 26, a third magnetoresistor 30, and a fourth magnetoresistor 28 forming a Wheatstone bridge. The first and second magnetoresistors 24 and 26 are coupled in series from a first power supply terminal 44 to a second power supply terminal 40/48, and the third and fourth magnetoresistors 30 and 28 are coupled in series from the second power supply terminal 40/48 to the first power supply terminal 44. A current strap 70 produces a magnetic field over the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28 in the same direction.

A set-reset strap 54 extends in a clockwise direction and includes segments 60, which pass above the fourth and third magnetoresistors 28 and 30, and segments 62, which pass above the first and second magnetoresistors 24 and 26. With a current entering pad 56 and leaving at pad 58, the current in segments 60 causes a magnetization in the fourth and third magnetoresistors 28 and 30 in a first direction towards a central part of die 20 and the current in segments 62 causes a magnetization in the first and second magnetoresistors 24 and 26 in a second direction towards

a central part of die 20, where the first and second directions are opposite to one another.

Independent claim 37 - The set-reset strap 54 is not disposed so that current flowing through it's portions that are adjacent to the magnetoresistors is parallel to the current flowing through the magnetoresistors. Instead, the set-reset strap 54 is disposed so that current flowing through it's portions that are adjacent to the magnetoresistors is perpendicular to the current flowing through the magnetoresistors.

The Examiner argues that the current through the top and bottom portions of the set-reset strap 54 as viewed in Figure 1 is parallel to the current in the magnetoresistors. However, these portions are not adjacent to the magnetoresistors.

The current strap 70 disclosed in the Wan patent is not disposed as required by independent claim 37. That is, the input strap 70 is not disposed with respect to the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28 so that a magnetic field is generated over the first and second magnetoresistors 24 and 26 in one direction, and so that

a magnetic field is generated over the third and fourth magnetoresistors 30 and 28 in an opposite direction.

Instead, current flowing through the input strap 70, depending on polarity, enters the input strap 70 at the pad 66 and exits the input strap 70 at the pad 68. Accordingly, the current flows along the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28 in the same direction producing a magnetic field over all of the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28 in the same direction.

Accordingly, the Wan patent does not disclose a coil that meets the limitations of independent claim 37.

Therefore, the Wan patent does not anticipate independent claim 37.

Because the Wan patent does not anticipate independent claim 37, and the Wan patent does not anticipate dependent claims 3-10 and 31-35.

In addition, dependent claims 4 and 5 recite that each of the magnetoresistors comprises a serpentine structure having a plurality of elongated magnetoresistive portions coupled end-to-end, and that the elongated portions of the magnetoresistors are

positioned near and in parallel to elongated portions of the input strap.

As shown in Figure 1 of the Wan patent, the elongated portions of the magnetoresistors are perpendicular, not parallel, to the elongated portions of the set-reset strap 54 that are near the magnetoresistors.

For this additional reason, dependent claims 4 and 5 are not anticipated by the Wan patent.

Dependent claim 9 recites a set-reset coil that momentarily sets and resets a direction of magnetization of the first, second, third, and fourth magnetoresistors, and that runs across the first, second, third, and fourth magnetoresistors.

Because the Wan patent discloses the set-reset coil 54 as a set-reset coil, then the coil 70 must necessarily be the input coil according to the Examiner's rejection. The input coil 70 does not meet the limitations regarding the input strap of the rejected claims. Moreover, reversing the roles played by the set-rest coil 54 and the coil 70 is not according to the disclosure of the Wan patent. Therefore, the Wan patent cannot anticipate dependent claim 9.

Independent claim 11 - The set-reset strap 54 is not disposed so that current flowing through it is parallel to the current flowing through the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28.

With respect to other claims, the Examiner asserts that the portions of the set-reset strap 54 at the top and bottom of the device 10 as viewed in Figure 1 have current that is parallel to the current through the magnetoresistors. However, these portions do not run lengthwise alongside the magnetoresistors. Furthermore, these portions do not run lengthwise alongside only the first and second magnetoresistors and only the third and fourth magnetoresistors.

Therefore, the set-reset coil 54 does not meet the input strap limitations of independent claim 11.

Moreover, the input strap 70 is not disposed as required by independent claim 11. That is, the input strap 70 does not a first portion that runs lengthwise alongside only the first and second magnetoresistors and a second portion that runs lengthwise alongside only the third and fourth magnetoresistors.

Accordingly, the Wan patent does not disclose a coil that meets the limitations of independent claim 11.

Therefore, the Wan patent does not anticipate independent claim 11 and dependent claims 12-17.

Dependent claim 16 further recites a set-reset coil having a plurality of clockwise turns and a plurality of counterclockwise turns. The set-reset coil momentarily sets and resets a direction of magnetization of first, second, third, and fourth magnetoresistors. Each clockwise turn of the set-reset coil has a portion running across the first and fourth magnetoresistors, each counterclockwise turn of the set-reset coil has a portion running across the second and third magnetoresistors, and the clockwise and counterclockwise turns are arranged so that current supplied to the set-reset coil flows through the portions of each of the clockwise and counterclockwise turns in the same direction.

Because the Wan patent discloses the set-reset coil 54 as a set-reset coil, then the coil 70 must necessarily be the input coil according to the Examiner's rejection. The input coil 70 does not meet the limitations regarding the input strap of the rejected claims. Moreover, reversing the roles played by the set-rest coil 54 and the coil 70 is not according to the

disclosure of the Wan patent. Therefore, the Wan patent cannot anticipate dependent claim 16.

For this additional reason, dependent claim 16 is not anticipated by the Wan patent.

Dependent claim 17 further recites a set-reset coil having a plurality of turns disposed with respect to the first, second, third, and fourth magnetoresistors so that the set-reset coil generates a momentary magnetic field across the first, second, third, and fourth magnetoresistors in the same direction.

Because the Wan patent discloses the set-reset coil 54 as a set-reset coil, then the coil 70 must necessarily be the input coil according to the Examiner's rejection. The input coil 70 does not meet the limitations regarding the input strap of the rejected claims. Moreover, reversing the roles played by the set-rest coil 54 and the coil 70 is not according to the disclosure of the Wan patent. Therefore, the Wan patent cannot anticipate dependent claim 17.

For this additional reason, dependent claim 17 is not anticipated by the Wan patent.

Independent claim 36 - The set-reset strap 54 is not disposed so that current flowing through its portions that are immediately adjacent to the first,

second, third, and fourth magnetoresistors is parallel to the current flowing through the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28.

Accordingly, the set-reset coil 54 is not disposed as required by independent claim 36.

Moreover, the input strap 70 is not disposed as required by independent claim 36. That is, the input strap 70 is not disposed with respect to the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28 so that a magnetic field is generated over the first and second magnetoresistors 24 and 26 in one direction, and so that a magnetic field is generated over the third and fourth magnetoresistors 30 and 28 in an opposite direction.

Instead, current flowing through the input strap 70, depending on polarity, enters the input strap 70 at the pad 66 and exits the input strap 70 at the pad 68. Accordingly, the current flows along the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28 in the same direction producing a magnetic field over all of the first, second, third, and fourth magnetoresistors 24, 26, 30, and 28 in the same direction.

Accordingly, the Wan patent does not disclose a coil that meets the limitations of independent claim 36.

Therefore, the Wan patent does not anticipate independent claim 36.

Independent claim 37 - The portions of the set-reset coil 54 that are disposed adjacent to the magnetoresistors disclosed in the Wan patent do not carry a current that is parallel to the current in the magnetoresistors.

Accordingly, the set-reset coil 54 of the Wan patent does not meet the input strap limitations of independent claim 37.

The strap 70 disclosed in the Wan patent does not generate a magnetic field over the first and second magnetoresistors in one direction and a magnetic field over the third and fourth magnetoresistors in an opposite direction.

Accordingly, the strap 70 of the Wan patent does not meet the input strap limitations of independent claim 37.

Therefore, the Wan patent does not anticipate independent claim 37.

In section 6 of the Office Action, the Examiner rejected claims 3-8, 11-15, and 31-37 under 35 U.S.C.

§103 as being unpatentable over the Daughton patent in view of the Bohlinger patent.

The Daughton patent discloses a signal isolator formed as a portion of a semiconductor chip 10. An insulating layer 11 is provided over a first metalization interconnection network 12 to form a part of an upper surface 13 of the semiconductor chip 10 after a second and final chip metallization that forms a metalization interconnection network 14. The metalization interconnection networks 12 and 14 are provided on the semiconductor chip 10 for interconnecting various integrated circuit components.

The semiconductor chip 10 includes a NiFeCo alloy layer 16 and a CoFe alloy layer 17. The NiFeCo alloy layer 16 is provided on a base metal layer 15. The CoFe alloy layer 17 is provided on the NiFeCo alloy layer 16 and has a magnetic saturation induction that is higher than that of the NiFeCo alloy layer 16. An intermediate nonmagnetic electrical conductor layer 18 is provided on the CoFe alloy layer 17. A hard ferromagnetic thin-film CoFe layer 19 is formed on the intermediate nonmagnetic electrical conductor layer 18. An antiferromagnetic IrMn layer 20 is formed on the hard ferromagnetic thin-film CoFe layer 19. A tantalum passivation layer 21 is formed

over the antiferromagnetic IrMn layer 20. An etch stop layer 22 is deposited on the tantalum passivation layer 21.

A photoresist is deposited and patterned with a photomask, and etch and milling steps are performed to form four separated magnetoresistors 23A, 23B, 23C, and 23D which serve as members of a current sensor bridge circuit. The magnetoresistors 23A, 23B, 23C, and 23D are connected to leads 24A, 24B, 24C, 24D, 24E, 24F, 24G, and 24H.

The leads 24A and 24D connect the magnetoresistors 23B and 23D together, and the leads 24B and 24C connect the magnetoresistors 23A and 23C together. The lead 24E connects the magnetoresistors 23A and 23B to a positive voltage supply. The lead 24F connects the magnetoresistors 23C and 23D to a ground reference. The lead 24G is connected to the junction between the magnetoresistors 23A and 23C to form a first bridge output which is coupled to an input of an amplifier. Similarly, the lead 24H is connected to the junction between the magnetoresistors 23B and 23D to form a second bridge output which is coupled to another input of the amplifier.

Accordingly, in terms of the bridge defined by independent claims 11, 36, and 37, if the magnetoresistor 23B is chosen as the first magnetoresistor, then the magnetoresistor 23D is the second magnetoresistor, the magnetoresistor 23C is the third magnetoresistor, and the magnetoresistor 23A is the fourth magnetoresistor. (It is noted that the magnetoresistor 23B is arbitrarily chosen as the first magnetoresistor of the claims. However, the analyses contained in this response are the same regardless of which of the magnetoresistors 23A, 23B, 23C, and 23D is chosen as the first magnetoresistor).

A silicon nitride insulating layer 25 is deposited over the magnetoresistors 23A, 23B, 23C, and 23D and the associated leads 24A-24H. Openings are formed through the silicon nitride insulating layer 25 to provide appropriate connections to the bridge. An electric field interrupter layer 26B is provided over the silicon nitride insulating layer 25 and is connected to the ground reference.

A dielectric layer 27 is provided between an input coil 29 and the electric field interrupter 26B, and also between the magnetoresistors 23A, 23B 23C, and 23D and the electric field interrupter 26B. A mechanically

stiffening layer 28 is provided on the dielectric layer 27 to provide a firmer base for supporting the input coil 29. The input coil 29 and corresponding pads 30 are then formed.

A further dielectric layer is then coated on the input coil 29, the pads 30, the exposed sides of he stiffening layer 28, the exposed surfaces of the dielectric layer 27, and the exposed surfaces of the interconnection network 14 leaving expose portions of the relevant bonding pads.

As shown in Figure 1A, the turns of the input coil 29 extend over the magnetoresistors 23A, 23B 23C, and 23D, crossing them perpendicularly. Accordingly, the long sides of the magnetoresistors 23A, 23B, 23C, and 23D are perpendicular to the direction of the portions of the coil 29 that pass near the magnetoresistors 23A, 23B, 23C, and 23D. Thus, a current in the coil 29 generates magnetic fields which are perpendicular to the coil 29 and parallel to the elongated portion sides of the magnetoresistors 23A, 23B, 23C, and 23D.

Current in the coil 29 flows in opposite directions over the first and second magnetoresistors 23B and 23D. Therefore, the first and second magnetoresistors 23B and 23D experience magnetic fields

in opposite directions. Similarly, current in the coil 29 flows in opposite directions over the third and fourth magnetoresistors 23C and 23A. Therefore, the third and fourth magnetoresistors 23C and 23A experience magnetic fields in opposite directions.

Independent claim 37 - As discussed above, one distinction of independent claim 37 over the Bohlinger patent is that the currents through the portions of the coil 14 closest to their corresponding magnetoresistors flow in a direction that is perpendicular, not parallel, to the direction of current flow through their corresponding magnetoresistors. The Daughton patent does not remedy this failing of the Bohlinger patent because, as disclosed in the Daughton patent, the currents through the portions of the coil 29 closest to their corresponding magnetoresistors also flow in a direction that is perpendicular, not parallel, to the direction of current flow through their corresponding magnetoresistors.

Therefore, even if the Bohlinger patent and the Daughton patent could be combined, the combination would not met the limitations of independent claim 37. Accordingly, independent claim 37 is not unpatentable over the Daughton patent in view of the Bohlinger patent.

Because independent claim 37 is not unpatentable over the Daughton patent in view of the Bohlinger patent, dependent claims 3-8 and 31-35 are likewise not unpatentable over the Daughton patent in view of the Bohlinger patent.

Independent claim 11 - The Daughton patent does not disclose a first portion of the coil 29 that runs lengthwise alongside only the first and second magnetoresistors such that the current flowing through this first portion is parallel to the direction of current flow through the first and second magnetoresistors as required by independent claim 11. That is, to be consistent with the claim language of independent claim 11, one of the first and second magnetoresistors disclosed in the Daughton patent must necessarily be on the top portion of the coil 29 as viewed in Figure 1 of the Daughton patent, and the other of the first and second magnetoresistors disclosed in the Daughton patent must necessarily be on the bottom portion of the coil 29 as viewed in Figure 1 of the Daughton patent. Therefore, the coil 29 cannot have a first portion that runs lengthwise alongside only the first and second magnetoresistors such that the current flowing through the first portion is parallel to the direction of

current flow through the first and second magnetoresistors.

These comments similarly apply to the third and fourth magnetoresistors.

Similarly, as shown in the Bohlinger patent, the current in the part of the coil 14 that passes by the first and second magnetoresistors 30 and 32 (or 28 and 20) is perpendicular to the current flowing through the first and second magnetoresistors 30 and 32, not parallel to it.

As a result, the Daughton patent and the Bohlinger patent cannot be combined to meet the limitations of independent claim 11. Accordingly, independent claim 11 is not unpatentable over the Daughton patent in view of the Bohlinger patent.

Because independent claim 11 is not unpatentable over the Daughton patent in view of the Bohlinger patent, dependent claims 12-17 are likewise not unpatentable over the Daughton patent in view of the Bohlinger patent.

Independent claim 36 - The Daughton patent does not disclose that the current flowing the portions of the coil 29 that are immediately adjacent to the first, second, third, and fourth magnetoresistors is parallel to

current flowing through the first, second, third, and fourth magnetoresistors as recited in independent claim 36.

Similarly, the Bohlinger patent does not disclose that the current flowing the portions of the coil 14 that are immediately adjacent to the first, second, third, and fourth magnetoresistors is parallel to current flowing through the first, second, third, and fourth magnetoresistors as recited in independent claim 36.

As a result, the Daughton patent and the Bohlinger patent cannot be combined to meet the limitations of independent claim 36. Accordingly, independent claim 36 is not unpatentable over the Daughton patent in view of the Bohlinger patent.

New independent claim 38 recites that the input strap has a first portion disposed in relation to the first magnetoresistor so that an axis passing perpendicularly through a plane of the first portion and through a plane of the first magnetoresistor passes through the first portion and the first magnetoresistor and so that a current flowing through the first portion of the input strap is parallel to the current flowing

through the first magnetoresistor. The second, third, and fourth magnetoresistors are similarly defined.

None of the references show this construction. Therefore, independent claim 38 is patentable over the references applied by the Examiner.

Independent claim 39 is directed to an integrated signal isolator having first, second, third, and fourth magnetoresistors, an input strap, and a set-reset coil. The first, second, third, and fourth magnetoresistors are coupled in a Wheatstone bridge where the first and second magnetoresistors are coupled in series between the first and second power supply terminals and the third and fourth magnetoresistors are similarly coupled in series between the first and second power supply terminals. A current through the input strap generates a magnetic field over the first and second magnetoresistors in one direction and generates a magnetic field over the third and fourth magnetoresistors in an opposite direction. The set-reset coil generates a momentary magnetic field across the first, second, third, and fourth magnetoresistors in the same direction.

The Wan patent does not disclose such an arrangement. In an effort to meet these limitations, the Examiner has referred to the coil 54 in the Wan patent as

an input coil and the coil 70 as a set-reset coil. However, the Wan patent does not disclose this arrangement. Instead, the Wan patent discloses that the coil 54 is a set-reset coil and that the coil 70 is a coil that does not provide a set-reset function. Accordingly, because the Wan patent does not disclose the arrangement that the Examiner has conjured, the Wan patent cannot anticipate the rejected claims.

The Examiner cannot simply transfer functions between devices disclosed in a reference and then apply the result as an anticipation.

The other art applied by the Examiner does not disclose the invention of independent claim 39.

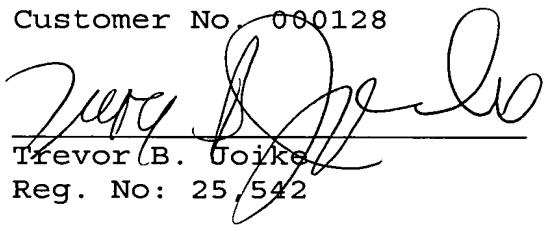
Accordingly, independent claim 39 is patentable over the references applied by the Examiner.

CONCLUSION

In view of the above, it is clear that the claims of the present application patentably distinguish over the art applied by the Examiner. Accordingly, allowance of these claims and issuance of the above captioned patent application are respectfully requested.

Respectfully submitted,

Schiff Hardin LLP
6600 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606
(312) 258-5500
Customer No. 000128

By: 
Trevor B. Uoike
Reg. No: 25,542

December 19, 2005